to be shown in the drawings. In response to this objection, Claim 3 has been cancelled.

At the outset, Applicants would like to thank Examiner Hannaher for the courtesy extended their counsel during a personal interview conducted on May 4, 1995. During the personal interview, each of the rejections set forth in the Office Action were discussed. Applicants have amended the claims in a sincere effort to incorporate the suggestions of the Examiner and to distinguish the claims over the references of record. Additionally, new Claims 31-34 have been added by this amendment. Applicants respectfully request entry and favorable consideration of new Claims 31-34.

In the Office Action, the specification was objected to under 35 U.S.C. § 112, first paragraph, as failing to adequately teach how to create the claimed expression "creating a visual overlay...displaying the image signal in conjunction...". This rejection was discussed during the personal interview. Applicants respectfully request reconsideration of this rejection in view of the understanding that "superimposition" is the requisite act recited in the specification for accomplishing the claimed subject matter. More specifically, the specification on Page 6, lines 28-33 specifically discloses that the system may include structure for creating a visual overlay of an area in the field of view of the gamma ray imaging system and displaying the image signal in conjunction with the visual overlay of the area. In this manner, the gamma ray image is superimposed on a pictorial overlay of the area and "hot spots" can be easily determined. This feature is also discussed in the specification from Page 8, lines 32 - Page 9, line 10. Accordingly, in view of the

enabling disclosure in the specification as originally filed, Applicants respectfully request reconsideration of the rejections under 35 U.S.C. § 112, first paragraph.

Claims 3 and 18 have been rejected under 35 U.S.C. § 112, first paragraph, for the same reasons set forth with respect to the objections in the specification. Furthermore, Claims 3 and 18 have been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. In response to these rejections, Claim 3 has been cancelled, and the subject matter of Claim 18 has been incorporated into Claim 17. In view of the personal interview, amendments to the subject matter of Claim 18 now in Claim 17 and further in view of the portions of the specification noted above, Applicants respectfully request reconsideration of the rejection of Claim 18 under 35 U.S.C. § 112, second paragraph.

In the Office Action, Claims 1, 2, 4-9, 13, 15-17 and 19-21 were rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 4,209,780 to Fenimore, et al. in view of U.S. Patent No. 5,308,986 to Walker. The Examiner contends that the Fenimore, et al. reference discloses a gamma ray imaging system comprising a coded aperture, a position sensitive detector, a signal processor and a display. The Examiner notes that although the Fenimore, et al. reference describes the position sensitive detector as an Anger camera, those of ordinary skill in the art recognize that alternative position sensitive detectors are known for the purpose of imaging gamma rays. For this purpose, the Examiner notes that the Walker reference is a gamma ray imaging system comprising a position sensitive detector, an array of charge coupled devices

and a signal processor. The Examiner contends that in view of the improved resolution for radiographic imaging described by Walker, it would have been obvious to one of ordinary skill in the art to replace the position sensitive detector disclosed in the Fenimore, et al. reference with an array of charge coupled devices as shown by the Walker reference.

With respect to Claims 4-6, 7-8, 9 and 13, the Examiner contends that the subject matter of each of these claims is disclosed in the Walker reference. With respect to Claims 15 and 16, the Examiner contends that choices of cross-sectional area and field of view are within the ordinary skill of the art in view of the intended application for the system.

Claim 17 has been rejected for the same reason set forth above with respect to Claim 1. The subject matter of Claims 19-21 has been rejected as being disclosed in the Walker reference.

Claims 10-12 and 22 have been rejected under 35 U.S.C. § 103 as being unpatentable over the Fenimore, et al. reference in view of the Walker reference and further in view of U.S. Patent No. 5,122,671 to Buchanan, et al. The Examiner contends that although the Walker reference discloses a plastic scintillator, those of ordinary skill in the art recognize that glass scintillators are also useful in radiographic applications. The Examiner cites the Buchanan, et al. reference as describing a glass scintillator and its effectiveness. The Examiner contends that it would have been obvious to one of ordinary skill in the art to replace the plastic scintillator disclosed in the Walker reference with a glass scintillator as disclosed in the Buchanan, et al. reference.

Claim 14 has been rejected under 35 U.S.C. § 103 as being unpatentable over the Fenimore, et al. reference in view of French Patent No. 2,626,679 to Walter. The Examiner contends that the Fenimore, et al. reference discloses a gamma ray imaging system comprising a coded aperture, a position sensitive detector, a signal processor and a display. The Examiner contends that although the Fenimore, et al. reference describes the position sensitive detector as an Anger camera, those of ordinary skill in the art recognize that alternative position sensitive detectors are known for the purpose of imaging gamma rays. The Examiner notes that the Walter reference is an example of a gamma ray imaging system wherein the system comprises a single crystal scintillator and an array of charge coupled devices. The Examiner concludes that it would have been obvious to one of ordinary skill in the art to replace the position sensitive detector in the Fenimore, et al. reference with a crystal scintillator and an array of charge coupled devices as disclosed by Walter.

Claims 23-30 have been cancelled by this amendment. Accordingly, no further discussion of these claims is necessary.

Independent Claims 1, 17 and 19 have been amended to more particularly point out and distinctly claim those features of Applicants' invention which distinguish over the art of record. More specifically, each of the independent claims has been amended to specifically recite that the at least one gamma ray emitting source is a source of non-focusable radiation. Furthermore, each of new Claims 31 and 32, which depend upon amended independent Claims 1 and 19, respectively, have been amended to further define that the array of charge coupled

devices is thermoelectrically cooled to improve the signal-to-noise ratio. Lastly, each of the independent Claims 1, 17 and 19 have been amended to include the feature of displaying an image signal superimposed on a visual representation of an area in the field of view of the gamma ray imaging system.

New Claim 33 is an independent claim defining a preferred embodiment of the present invention. More specifically, the preferred embodiment includes a number of elements such as a uniformly redundant array, a glass fiber scintillator, an optical fiber taper, a multistage image intensifier tube, an array of charge coupled devices, a digital signal processor and a monitor to display an image representative of the radiation emitting source. Applicants respectfully urge that the combination of elements, when arranged as defined in new Claim 32, provides significantly enhanced spatial resolution, improved signal-to-noise ratio and greater sensitivity than any known radiographic imaging system to date. Furthermore, none of the references of record, either alone or in combination, teach or suggest the claimed imaging system defined in new Claim 33.

New Claim 34 is directed to a method of scanning a potentially hazardous radiation area using a hand-held imaging device constructed in accordance with the present invention. The hand-held device is coupled to a remote location for displaying an image signal generated in response to radiation emitted from at least one source and received by the hand-held imaging device. Applicants respectfully urge that none of the references of record teach or suggest a portable system for scanning potential radiation hazards.

Support for the new Claims 31-34 and the amendments to Claims 1, 17 and 19 can be found in the specification as originally filed. More specifically, support for the subject matter of new Claims 31-32 can be found on Page 18, lines 26-35. Support for new Claims 33 and 34 can be found in the specification as a whole. Support for the amendments to the claims directed to the display having the image signal superimposed on a visual representation of an area in the field of view of the system can be found in the specification on Page 6, lines 28-33 and Page 8, line 26 through Page 9, line 10.

As noted above, each of Claims 1, 17 and 19 have been amended to more specifically define the system as generating an image from a source of non-focusable gamma radiation. Furthermore, each of the claims have been amended to more specifically recite that the imaging system can generate images for multiple sources within the field of view of the device. For example, in a nuclear power plant setting, multiple valves in a field of view of the device can be imaged and displayed on a visual representation of the area in a field of view of the device. Accordingly, anyone viewing the display can easily determine whether or not the valves are emitting gamma radiation and, if radiation is being emitted, the exact location for the source of the radiation is readily illustrated so that preventative measures can be taken to limit exposure to workers required to be in the vicinity of the valves.

The gamma ray imaging system of the present invention is also directed to a system having high sensitivity to low level radiation. One method of increasing sensitivity is to reduce the signal-to-noise ratio of the charge coupled devices which convert the optical signal into an electrical signal. As now

recited in new Claims 31-32, the signal-to-noise ratio of the charge coupled devices may be improved by thermoelectrically cooling the array. For example, the array of charge coupled devices is preferably cooled with a two-stage thermoelectrical cooler. Typically, operating arrays of charge coupled devices operating at 16 frames per second have a noise equivalent irradiance of about $2.5 \times 10^{-9} w\text{-}cm^{-2}$. By cooling the array of charge coupled devices, the noise equivalent irradiance can be reduced to about $6.5 \times 10^{-12} w\text{-}cm^{-2}$. Accordingly, the claimed imaging system provides improved sensitivity and reliability.

As now specifically defined in amended Claim 8, sensitivity of the system may also be improved by utilizing a multistage image intensifier tube interposed between the position sensitive detector and the array of charge coupled devices.

Each of Claims 1, 17 and 19 have been rejected under 35 U.S.C. § 103 as being unpatentable over the Fenimore, et al. reference in view of the Walker reference. The Fenimore, et al. reference discloses a system utilizing a uniformly redundant array to image a source of non-focusable radiation. The imaging system further includes a non-focusable radiation detector means such as an X-ray detector, neutron detector or cosmic radiation detector for detecting an encoded image and means for balance correlating the encoded image to generate a decoded image of the source. The essence of the Fenimore, et al. invention was the use of a uniformly redundant array to allow imaging of low intensity sources and to eliminate artifacts. The system described in the Fenimore, et al. reference utilizes an Anger camera as the detector mentioned above.

An Anger camera detects emitted photons from a gamma source and produces an X and Y position for the detected location of the emitted photons. The X and Y signal is converted to a digital position by an A to D converter. The digital signal is then applied to a dual parameter pulse-height analyzer which increments the appropriate memory location. In this manner, the image projected on the detector is stored for subsequent processing. Once all the data has been recorded in memory, the device includes a means to reconstruct an image of the emitting source on a display.

The Walker reference discloses an X-ray camera utilizing a new scintillating optical fiber having an inner plastic core fiber which is transparent to visible radiation and has an index of refraction of about 1.45 or greater. The plastic core fiber comprises a polymeric matrix material, a metal moiety and an organic quench-resistant flourescent material. Additionally, the inner plastic core material has a plastic cladding material which has an index of refraction less than that of the inner plastic core fiber. The Walker system includes the new scintillating optical fiber to form the scintillator plate which converts penetrating radiation incident thereon to visible radiation to form a photon image, a charged coupled device to convert the photon image into an electrical signal and a monitor to convert the electrical signal to a visible image. Lastly, the radiographic imaging system disclosed in the Walker reference utilizes a controlled source, such as collimated radiation, to produce an image of an object placed between the source and the scintillator plate. As disclosed, the Walker system could not be used to image non-focusable radiation since the detector would receive radiation at various incident angles and the decoder for the electrical

signals could not decipher the random electrical signals which would be produced by the array of charge coupled devices.

Applicants respectfully urge that amended Claims 1, 17 and 19 now distinguish over each of the references of record. Neither the Fenimore, et al. reference nor the Walker reference teaches or suggests superimposing the image signal onto a visual representation of an area in the field of view of the device as now specifically defined in Claims 1, 17 and 19. This technique is especially useful in displaying multiple sources such as valves or radioactive materials being stored in canisters. As discussed during the personal interview, the system of the present invention can visually indicate which of a plurality of containers include a gamma ray emitting source.

Additionally, although the Fenimore, et al. reference discloses an imaging system for non-focusable radiation, the system utilizes an Anger camera to generate the image. As discussed in response to the last Office Action, the imaging system of the present invention is extremely more compact and provides higher sensitivity and a wider dynamic range than commonly known Anger cameras. The Walker reference does not teach or suggest an imaging system for non-focusable radiation, but rather an X-ray camera using a controlled radiation source. As previously noted, the Walker reference teaches the use of collimated radiation to produce an image on an object placed between the source and the detector. Accordingly, the Walker reference, which teaches use of a collimated radiation source and, the Fenimore, et al. reference which teaches imaging non-focusable radiation, teach away from one another with respect to a combination of the two systems. Contrary to the assertions in the Office Action, Applicants respectfully urge

that a combination of a uniformly redundant array to image non-focusable radiation and an imaging system including an array of charge coupled devices would not have been obvious to one of ordinary skill in the art at the time the invention was made in view of the teachings in the Fenimore, et al. and Walker references. The Walker reference does not address any of the problems associated with imaging non-focusable radiation such as cross-talk and spatial resolution. The Fenimore, et al. reference does not teach or suggest the claimed elements of the system, excluding the coded mask. Applicants respectfully request reconsideration of the rejections under 35 U.S.C. § 103 relating to the obviousness of the claimed invention, as a whole, in view of the reasons set forth above.

Dependent Claim 8 further includes patentably distinguishable subject matter over the references of record. More specifically, Claim 8, as now amended, specifically recites the use of an image intensifier comprising a multistage image intensifier tube to provide improved system sensitivity. None of the references of record teach or suggest the use of a multistage image intensifier tube in conjunction with the claimed combination of elements to improve sensitivity of the system overall.

New Claims 31 and 32, specifically define that the array of charge coupled devices are thermoelectrically cooled to improve signal-to-noise ratio. None of the references of record teach or suggest thermoelectrically cooling the array of charge coupled devices in conjunction with the claimed combination of elements to improve overall system sensitivity. Accordingly, new Claims 31 and 32 are urged to include patentable subject matter.

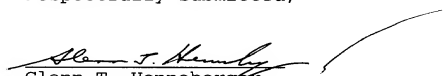
New Claim 33 specifically defines a preferred embodiment of the present invention. Claim 33 is a combination of elements which, when taken as a whole, are not taught or suggested by any of the references of record either alone or in combination. This combination, as a whole, provides a unique radiation imaging system having vastly improved signal-to-noise ratio, high sensitivity, and a large field of view. Accordingly, new Claim 33 is respectfully urged to distinguish over each of the references of record.

New Claim 34 is directed to a novel method of scanning facilities having a plurality of potential radiation sources utilizing the imaging device of the present invention. The method defined in new Claim 34 includes displaying a representative image of at least one radiation source at a remote location from a hand-held portable radiation imaging device and superimposing the representative image onto a visual representation of an area in the field of view of the portable imaging device to specifically illustrate the source of radiation. None of the references of record, alone or in combination, teach or suggest a hand-held, portable radiation imaging system or the specific display generated by the system as defined in new Claim 34. Accordingly, Applicants respectfully urge that new Claim 34 patentably distinguishes over the references of record.

The remainder of the claims remaining in the application are dependent upon either independent Claim 1 or 19. Accordingly, each of these claims patentably distinguish over the references of record for the same reasons set forth above with respect to Claims 1 and 19.

In view of the foregoing amendments and remarks, entry and favorable consideration of the amendments to Claims 1, 8, 17 and 19, new Claims 31-34, favorable reconsideration of Claims 4-7, 9-16 and 20-22 and allowance of the application with Claims 1, 4-17, 19-22 and 31-34 are respectfully solicited.

Respectfully submitted,



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